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PROPERTIES OF DUST AND CLOUDS IN THE MARS ATMOSPHERE: ANALYSIS OF VIKING IRTM EMISSION PHASE FUNCTION SEQUENCES;

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An analysis of emission-phase-function (EPF) observations from the Viking Orbiter infrared thermal mapper (IRTM) yields a wide variety of results regarding dust and cloud scattering in the Mars atmosphere and atmospheric-corrected albedos for the surface of Mars. Several hundred of these EPF sequences were returned during the Viking Orbiter missions, in which the visual brightness (solar band $\bar{\lambda}$=.67 μm, 0.3 - 3.0 μm band width) of the surface/atmosphere over a given region was viewed over a substantial range of phase angles as the spacecraft passed overhead. These observations include polar latitudes, the Viking Lander sites, and other regions of specific interest such as Olympus Mons and the Hellas basin. They also span a considerable range of solar longitude (L_S), including periods before, during, and after the global dust storms of 1977, and periods of polar hood formation at mid-latitudes and spring clouds at northern polar latitudes.

A multiple scattering radiative transfer model incorporating a bidirectional phase function for the surface and atmospheric scattering by dust and clouds is used to derive surface albedos and dust and ice optical properties and optical depths for these various conditions on Mars. The specific photometric function of the surface of Mars is not well constrained by the EPF observations, although a resolved phase coefficient of ~ 0.01 mag/deg is indicated by low-phase-angle, low-dust-loading sequences for both bright and dark regions on Mars. The dust and cloud optical depths are well constrained by the increased scattering present at high phase angles (> 70°) within the EPF data. Furthermore, the single scattering albedos ($\tilde{\omega}_0$) and phase functions of dust and cloud particles are also well defined for EPF sequences in which the dust optical depths are large (τ > 0.5) and/or the range of observed phase angles is large (> 80°).

It is possible to fit all of the analyzed EPF sequences corresponding to dust scattering with $\tilde{\omega}_0$ = 0.92, compared to the value of 0.86 derived by Pollack et al. (1979) from Viking Lander observations. The derived dust scattering phase function agrees very well with the results of Pollack et al., although the resulting single scattering asymmetry parameter is 0.55 for both measurements rather than the value of 0.79 reported by Pollack et al. The observed dust phase function and the observed ratios of infrared and visible dust opacities suggest that dust particle sizes may be 5-10 times smaller than previous analyses have indicated. Observed dust optical depths range from 2 - 3 at the peak of the global dust storms to 0.2 after the second dust storm of 1977; a dust opacity of 0.8 is determined for the south polar region during the second global dust storm of 1977. Three dust opacity determinations coinciding with Viking Lander measurements provide consistency with the Viking Lander dust opacity measurements. The surface elevation dependence of dust loading over Olympus Mons is derived from an EPF sequence during the first global dust storm of 1977. EPF sequences corresponding to cloud scattering indicate **g** = 0.66 for mid-latitude fall clouds and **g** = 0.55 for north polar spring clouds, with $\tilde{\omega}_0$ = 1.0. Cloud opacities range from 0.2 - 0.7, with a typical value of 0.5 for both the fall mid-latitude and polar spring clouds. The global range of surface albedos resulting from this EPF analysis are ~10% darker for bright regions and ~25% darker for dark regions on Mars than are currently provided by studies that do not explicitly account for the effects of atmospheric scattering.

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REFERENCES: Pollack, J. B., D. S. Colburn, F. M. Flasar, R. Kahn, C. E. Carston, and D. Pidek (1979). Properties and effects of dust particles suspended in the martian atmosphere. *J. Geophys. Res., 84*, 2929-2945.